- *The dot plot keeps the original data about the 6 households. How does the location of the mean on the dot pot relate to the location of the individual dots?*
- *How does adding up the numbers and dividing by 6 relate to the cube stacks?*
- *For the two tables, the means are the same but the ranges are different. How is this possible?*

Note: The sets of data in this Problem are designed so that the mean will be a whole number. The cubes will all be the same height to indicate the mean. When you use more complicated data sets, the mean may involve a decimal or a fraction. When this happens, the cube stacks or value bars will have different heights.

Summarize

Suggested Questions

- *How does each model show the data before any evening out is done?*
- *How does each model show the data after the evening-out process is completed?*

ACE

Assignment Guide for Problem 2.1

Applications: 1–3 | Connections: 17–19

Answers to Problem 2.1

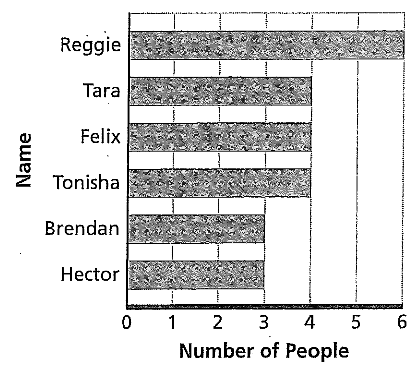
A. 1. Each dot on the dot plot represents an end point of the ordered-value bar graph. Since the bars are arranged horizontally, the ends of the bars line up with the locations of the values of the dots marking the size of the household on the dot-plot axis.

2. Answers will vary. There are several moves that will even out the bars.

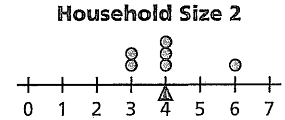
3. Some students will physically move the cubes or use the ordered-value bar graphs; some may see that there are 24 people to share among 6 households/stacks. The final stacks/bars will have 4 people each.

B. 1.

Household Size 2



Household Size 2



2. The mean is 4. Some students will even out value bars. Some will build the data values with cubes and even these out. Some will use an algorithm.

3. The mean is the same for both distributions (4), but the median is larger for Table 2 (4, as opposed to $3\frac{1}{2}$).

4. Once you have all the bars evened out, you have 6 bars, each 4 "cubes" long, so the ends of the bars line up vertically above 4 on the axis.

5. You can say that an average or typical household size is 4. Some are greater than this, some are less; 4 is an estimate that is not far from any of the original values.

Assignment Guide for Problem 2.2

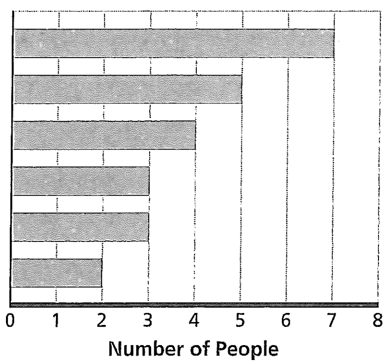
Applications: 4–7 | Connections: 20–25
Extensions: 33–34

Answers to Problem 2.2

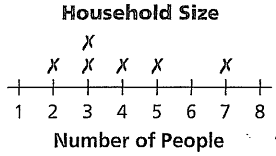
A. 1. Answers will vary. Possible example: 2, 3, 3, 4, 5, 7; sum is 24

2. Possible bar graph and line plot:

Household Size



Household Size



3. Answers will vary. Students may use the strategy of evening out.

4. a. Look at the length of the bar or at the data value below the ✗ on the axis.

b. Count the total number of bars or ✗s.

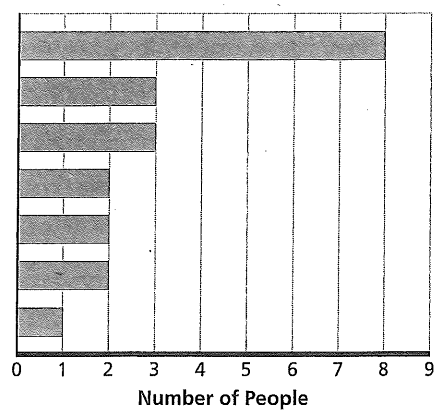
c. Add up the lengths of all bars or add up all data values on the axis below each ✗.

d. Even out the bars in the ordered-value bar graph. For the line plot, you can move each data value toward a central value as long as the number of moves for the values above the central value is the same as the number of moves for the values below the central value.

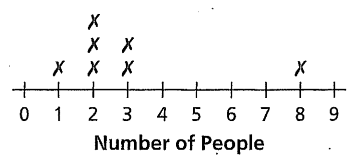
B. 1. Answers will vary. Possible example: 1, 2, 2, 2, 3, 3, 8; sum is 21

2. Possible bar graph and line plot:

Household Size



Household Size



3. Answers will vary. Students may use the strategy of evening out.

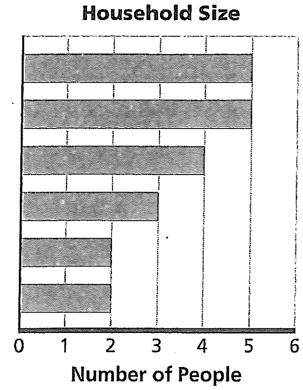
4. Answers will vary. Students may imagine the cube scenario, rearranging household sizes so that the bar graphs and line plots spread out to the left and/or right of the original range.

5. See the answers to Question A, part (4).

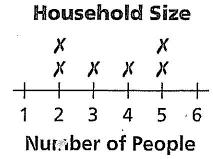
C. 1. Answers will vary. Possible example: 2, 2, 3, 4, 5, 5; sum is 21

2. Possible bar graph and line plot:

Household Size



Household Size



3. The mean does not have to be an actual or possible value from the data set.

D. 1. The median is 4 people, the mode is 4 people, and the range is 8 people.

2. Answers will vary. Guesses may be around 4–6 people.

3. The mean is 5 people. The mean is affected by the large households which have to be added into the total. Comparisons will vary based on estimates.

4. a. The median and mode are the same, the mean is not.

b. It is possible to have all three measures be the same or all three be different.

c. Answers may vary. At this point, students have not explored how to choose between using mean or median to describe what is typical.

E. Answers will vary. Most students will be ready to discuss the algorithm now. The mean is the number obtained by dividing the sum of all data values by the total number of data values. It is the value each data value would have if they were evened out.

Assignment Guide for Problem 2.3

Applications: 8–9 | Connections: 26–27

Answers to Problem 2.3

A. **1.** Store B: mean = \$51.94, median = \$50; Store C: mean = \$64.61, median = \$50

2. The median is the same for each distribution, i.e. the midpoint of each ordered set of data is \$50 (for Store B, the ninth data value and for Store C, between the ninth and tenth data values). The means respond to extreme values; for Store C, a data value of \$200 affects the mean. Since there are no extreme data values for Store B, the mean and the median are close in value.

B. **1.** (See Figure 1.)

2. mean = \$48.50; median = \$50

3. **Store A's New Stock**

New Stock Price	New Mean	New Median
\$200	\$56.47	\$50
\$180	\$62.65	\$50
\$180	\$68.24	\$50
\$160	\$72.41	\$50
\$170	\$76.65	\$50
\$140	\$79.29	\$55
Question B, part (4):		
\$200	\$81.79	\$55

4. The mean would increase; the median would stay the same.

5. The mean will change with the addition of each data value. The median's position changes, but the value of the median may not change if there are repeated values; if the value of the median does change, it is not sensitive to the actual data value.

6. The median gives a better estimate of the typical prices of skateboards; students may want to add, "but there are some higher-priced skateboards, too."

C. **1.** Graph 1: Skateboard Prices From Stores A and B; Graph 2: Skateboard Prices From Stores C and D. Possible explanation: Graph 2 has to show data from stores C and D because it contains values greater than 120. Stores A and B have maximum values of 120.

2. When there are extreme values, the mean will be more easily affected.

D. The mean is strongly influenced by any extreme observations that are included in the data set. The median is resistant to any extreme observations that the data set may include.

E. **1.** Symmetric: mean = 5, median = 5; In the symmetric distribution, the two measures are (in this case) identical (in most cases, they are similar). The graph's values are balanced around the center.

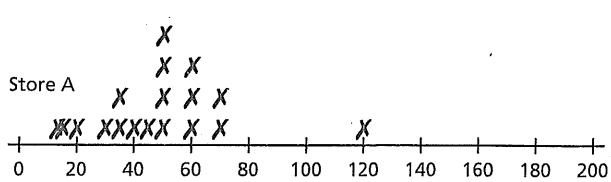
Skewed-left: mean = 7, median = 8; The mean is less than the median. The long tail on the left shifts the mean to the left of the median. Both values, however, are higher overall.

Skewed-right: mean = 4, median = 3; The mean is greater than the median. The long tail on the right shifts the mean to the right of the median. Both values, however, are somewhat low.

2. Symmetric: the overall trend is in the middle: "It's okay." In the skewed-left distribution, the overall trend is a positive rating: "Thumbs Up." In the skewed-right distribution, the overall trend is a negative rating: "Thumbs Down." Because of the skewed graphs, it is probably best to report the median in all cases.

Figure 1

Skateboard Prices



- *How would knowing how many students chose each pet help you figure out how many students are in the class?*
- *How many students have 1 pet?*
- *How many total pets do the bars over "1 pet" represent? How do you know?*
- *How many student have 0 pets?*
- *How would knowing how many students own a certain number of pets help you figure out how many students are in the class?*
- *Can you compute a mode for categorical data like "favorite kind of pet"? Why or why not?*
- *Can you compute a median for "favorite kind of pet"? Why or why not?*

Summarize

Have a class discussion in which teams of students explain their responses to the questions. It is important for students to understand what they can and cannot know from a set of data, and which statistics they can apply to categorical data and which to numerical data.

To complete this activity, you may want students to work in pairs to write some questions about these data that can and cannot be answered. For questions that cannot be answered, discuss what information would be needed to answer them. Then have students spend five minutes writing a brief summary report of whichever set they choose.

ACE

Assignment Guide for Problem 2.4

Applications: 10–16 | Connections: 28–32
Extensions: 35–37

Answers to Problem 2.4

A. The Favorite Pet graph shows categorical data. The Number of Pets graph shows numerical data.

B. **1.** 156 pets; Multiply each number of pets by its frequency and then add the results.

2. 21 pets; This is the highest number with a bar on top of it on the horizontal axis of the Number of Pets graph.

C. **1.** 26 students; Add up the values in the Frequency column of either of the frequency tables. Or, you can add up the heights of each of the bars in either graph.

2. 4 students; the bar for *cat* in the Favorite Pet graph is 4 units high.

3. This question cannot be answered. The information is not collected.

D. **1.** The mode is dog (it has the highest bar in the Favorite Pet graph); you can't compute the mean of categorical data.

2. median = 3.5 pets; range = 21 pets; data vary from 0 pets to 21 pets

E. **1.** This question cannot be answered. There is no way to distinguish Tomas.

2. This question cannot be answered. There is no way to distinguish girls from boys.

F. Student reports will vary. For example, using the median as a measure of center, you can say that a typical number of pets owned by these students is 3 or 4. The mean might be overly affected by the student who owns 21 pets, an unusually high number. The range for the number of pets is 21; this shows there is a great variability in the number of pets owned.

Suggested Questions

- *What were the medians and IQRs of the two sets of data?*
- *What does the median tell you? What does the IQR tell you?*

Assignment Guide for Problem 3.1

Applications: 1–3 | Connections: 12–13

Answers to Problem 3.1

A. 1. The median (Q2) is midway between 1.04 and 1.07, or 1.055 servings.

2. Q1 is midway between 0.86 and 0.96, or 0.91 serving.

3. Q3 is midway between 1.32 and 1.54, or 1.43 servings.

4. The median is the midway point. Q1 is the midpoint of the lower half of data values. Q3 is the midpoint of the upper half of data values.

5. Student answers may vary. The middle 50% of the data values vary from 0.96 to 1.32 servings. Most are at or above the ideal 1 serving, so these servings are typical of what students poured for this cereal. However, the servings are not "about right," if that means "close to 1 serving."

6. IQR = 1.43 − 0.91 = 0.52 serving.

B. 1. (See Figure 1.)

2. (See Figure 2.)

3. The median is 0.94 serving.

4. Q1 = 0.79 serving; Q3 = 1.165 serving

5. Servings from 0.85 to 1.09 servings are in this middle 50%. Most of these are at or below the ideal 1 serving.

6. IQR = 1.165 − 0.79 = 0.375 of a serving.

C. 1. The IQR is smaller for the servings of Raisin Flakes poured. The servings poured are more variable for Wheaty Os.

2. The IQR by itself cannot answer the under-or overpouring question. It can tell you how clustered the data values are around the median. But if the median is already far above the ideal serving size, then having a small IQR only tells you that half of the data is clustered around a "too large" median serving.

3. A typical serving size for Wheaty Os is between 0.91 serving and 1.43 servings, with a median of 1.055 servings. The typical serving size for Raisin Flakes is between 0.79 serving and 1.165 servings, with a median of 0.94 serving.

D. 1. Wheaty's Os range: 2.11 − 0.71 = 1.4
Raisin Flakes range: 1.33 − 0.45 = 0.88

2. The range is the difference between the minimum and maximum data values. The IQR is the difference between Q1 and Q3. Both represent spreads.

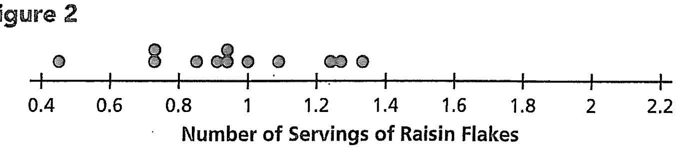
3. Comparing ranges students still see that servings poured for Wheaty Os vary more than for Raisin Flakes (just as the IQRs indicated).

Figure 1

Pours of Raisin Flakes

Grams Poured	44	33	31	24	42	31	28	24	15	36	30	41
Serving Size	1.33	1.00	0.94	0.73	1.27	0.94	0.85	0.73	0.45	1.09	0.91	1.24

Figure 2



E. Seamus's report concentrates on variability. It is all correct. This report tells you for which cereal students had less variability in their estimated serving sizes.

Deanna's report concentrates on measures of center and what students typically pour. This report answers the question about under- and overpouring, but it does not address the issue of variability.

A combination of the two reports would give a clearer picture: students are more consistent at estimating an ideal serving size for Raisin Flakes than they are for estimating an ideal serving size for Wheaty Os. Also, for Raisin Flakes, their estimates tend to fall below the ideal, and for Wheaty Os, they tend to fall above the ideal.

Suggested Questions

- *How might you compare these data sets?*
- *Using the median and IQR, how would you describe the distribution of grams of sugar for the cereals on the top shelf?*
- *Is there any other characteristic of the top-shelf distribution that you would like to note?*
- *What is the effect of the gap on the summary statistics?*

Students need to compare these groups of cereals to each other, with respect to the attribute grams of sugar. Make sure that students go beyond calculating statistics to using the statistics to make comparisons.

ACE

Assignment Guide for Problem 3.2

Applications: 4 | Connections: 17–20
Extensions: 26

Answers to Problem 3.2

A. **1.** There are a number of data values located at 3 grams or 6 grams. Data cluster in the intervals 0–3 grams and 5–15 grams.

2. Work with students to locate points. When they locate, for example, Bran-ful with 5 grams of sugar, they will see that there are actually five such cereals, each having 5 grams of sugar in a serving. You can discuss if it matters which exact dot is the one for Bran-ful.

B. **1.** For the cereals located on the bottom shelf, grams of sugar are clustered together. For the middle and top shelves, the data are more spread out. On the middle shelf, there are two gaps. On the top shelf, there are two larger gaps making 3 clusters of cereals. There appear to be three different kinds of cereals on the top shelf based on sugar content. To investigate the relation between placement of cereal and how sugary it is, students might compare measures of center. The medians are as such: top shelf, 3 grams of sugar; middle shelf, 11 grams of sugar; and bottom shelf, 7 grams of sugar.

2. **a.** The IQR for the bottom shelf is 4 grams of sugar ($Q1 = 5$; $Q3 = 9$).

The IQR for the middle shelf is 6 grams of sugar ($Q1 = 7$; $Q3 = 13$).

The IQR for the top shelf is 6.5 grams of sugar ($Q1 = 1.5$; $Q3 = 8$).

b. The top shelf has the greatest variability, but the middle shelf is similar in variability. The cereals on bottom shelf are the least variable in terms of sugar content.

3. A report should include a measure of center, such as median, and interpret this in a way that makes it clear that the typical amount of sugar is quite different depending on which shelf a cereal is located (See Question B, part (1)). Students already have the IQRs from Question B, part (2), so they might compare these and say that the top-shelf cereals show greatest variability. If they use range, however, then variability in grams of sugar does not differ much among the shelves. Students might also point out that some of the cereals on the top shelf have as much sugar as typical cereals on the middle shelf. They might point out the large gaps in the data from the top-shelf cereals. (These gaps affect the IQR and range for that data set.)

Suggested Questions

- *For the Carousel distribution, add the distances from each data value on the left side of the mean to the mean. Add the distances from each data value on the right side of the mean to the mean. What do you notice?*

ACE

Assignment Guide for Problem 3.3

Applications: 5–11 | Connections: 14–16, 21–25

Extensions: 27

Answers to Problem 3.3

A. **1.** Determine the data values from the graph; find their sum (250) and divide by the number of data values (10) to compute the mean, which is 25 minutes.

2. Focusing on using just the ordered-value bar graph helps students notice distances. This is not new in this context; students explored changing data values on ordered-value bar graphs to locate the mean in Investigation 2. They should be comfortable using this model to complete this question.

a. Find the distance between each data value and the mean. Then find the average distance from the mean. This tells you how much the data values vary, on average, from the mean value.

b. The average distance is 7.2; this means that the MAD is 7.2 minutes. On average, wait times vary by 7.2 minutes from the mean of 25 minutes.

c. The total of the distances from wait times greater than the mean to the mean is 36 minutes. The total of the distances from wait times less than the mean to the mean is also 36 minutes. Since the distribution of wait times should balance around the mean you would expect these totals to balance each other. If you were to even out the ordered value bar graph, you would take the "extra" distances above the mean and add these to the wait times below the mean, so that you ended up with all wait times at 25 minutes.

B. **1** The MAD is 1.8 minutes

2. The MAD for Scenic Trolley is 7.2 minutes, a larger value than that of the MAD for Carousel. You might choose the Carousel over the Scenic Trolley. It would most likely have a lesser wait time than the Scenic Trolley because the wait time is more consistently close to 25 minutes.

Note: Some students may say that they would choose Scenic Trolley because there is a chance with Scenic Trolley that the wait time will be very short; this is not likely, but there is still a chance, because the larger MAD also means there are wait times for Scenic Trolley that are much less than 25 minutes.

C. **1** The MAD is 3.6 minutes.

2. The mean wait time for Bumper Cars is 10 minutes and for Scenic Trolley, 25 minutes. However, the MAD for the Bumper Cars is 3.6 minutes, which is half the MAD for the Scenic Trolley. You would want to wait for the Bumper Cars since both the average wait time and MAD are less than those for the Scenic Trolley.

D. If you choose the Zip Line you are likely to wait between 20 and 24 minutes, 2 minutes more or less than the mean of 22. On the other hand, if you choose Alpine Slide, then on average you will wait 6–30 minutes, 12 minutes more or less than the mean of 18. Wait times of 27, 28, 29, and 30 minutes may be typical for this ride, and all of these would cause you a problem. So, it is more likely that you will have time for one last ride if you choose Zip Line.

Assignment Guide for Problem 4.1

Applications: 1–9 | Connections: 27
Extensions: 31

Answers to Problem 4.1

A. **1.** (See Figure 1.)

2. Answers will vary. Possible answers include: The first histogram shows larger intervals than the second histogram. That means that you can see more overall patterns for the data with the first histogram, whereas the second histogram shows more detailed data. Data cluster around 10–30 minutes in the histogram with an interval of 10. The histogram with 5-minute intervals unpacks these times a bit more so it looks like the cluster is actually between 15 and 25 minutes. There are no travel times less than 5 minutes, which is not clear from the histogram with 10-minute intervals. Both histograms show gaps and clusters.

B. Students whose travel times are 10 minutes or less are most likely to wake up the latest in the morning. You can find specific initials of these students in the table. Because they do not have to travel for as long, the students with a commute of 10 minutes or less can sleep longer.

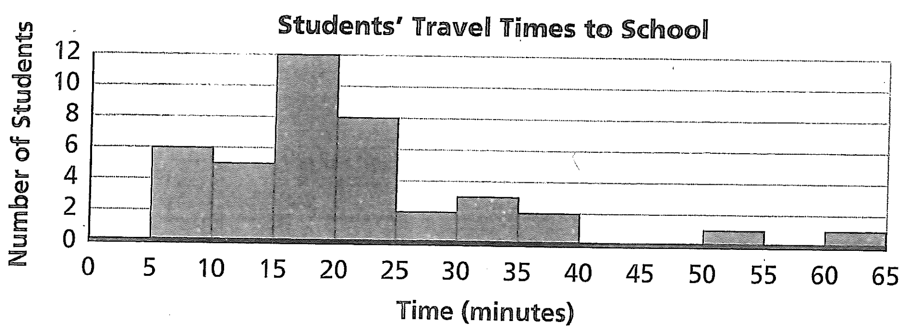
C. Students whose travel times are 50 to 60 minutes are most likely to wake up the earliest in the morning. You can find specific initials of these students in the table. Because they have to travel for a long time, the students with a 50-minute or 60-minute commute need to wake up earlier.

D. **1.** The mode travel time is 15 minutes, the median travel time is 16 minutes, and the mean travel time is 18.975 minutes. The range is 55 minutes; the data vary from 5 minutes to 60 minutes. You find the mode by identifying the most-frequent data value. You find the median by ordering the data values from least to greatest (or greatest to least) and then finding the midpoint. You find the mean by adding up all the data values then dividing that sum by the number of data values. You find the range by taking the difference of the maximum and minimum data values.

2. The mode, the mean, and the median all fall within the interval 10 minutes–20 minutes (or 15 minutes–20 minutes for the 5-minute-inverval histogram).

E. There is a difference between the median and mean travel times of almost 3 minutes. The median separates the distribution of travel times in half; 50% of the travel times are less than or equal to the value of the median, and 50% are greater than or equal to the median. Both measures fall into the same interval of data. There are two travel times that are unusual—50 and 60 minutes. These two extreme travel times are probably the reason that the mean is greater than the median. While there is no set rule about which to use, it may be more reasonable to choose the median, since the mean is skewed by the extreme travel times.

Figure 1



Summarize

Ask students to describe the procedure for making a box plot for a set of data: order data from least to greatest, identify the five-number summary, and draw the box and the whiskers in relation to a number line.

Suggested Questions

- *How does the shape of the box plot give you information about the distribution?*

ACE

Assignment Guide for Problem 4.2

Applications: 10–16 | Connections: 28–29

Answers to Problem 4.2

A. (See Figure 1.)

B. Initially, the evidence using graphs and the table suggests that Mr. K's class performed much better because of the higher-scoring students. In addition to the median being greater than Mrs. R's class, the mean is also greater (reflecting the few higher numbers of jumps). Some students may point out that Q1, Q2, and Q3 are similar for both classes, though slightly higher for Mr. K's class.

C. **1.** Anything higher than 137 is an outlier: 151, 160, 160, 300.

2. There are no outliers in Mrs. R's class.

D. **1.** The mean without the outliers is about 36.58. The median is 30. The mean with the outliers is 57.4 (and the median is 40.5, as indicated in the graphic).

2. The outliers pull both the mean and the median to the right, but they have more of an effect on the mean. The mean of the data including the outliers is 20.82 greater than the mean of the data not including the outliers. The median of the data including the outliers is only 10.5 greater than the median of the data not including the outliers.

3. Students are likely to want to discuss how much more similar the graphs of the two data sets are without the outliers included in the whisker. However, Mr. K's class's data is higher at three of the summary numbers, Q1, median, and Q3, so students can still say Mr. K's class is slightly better in this competition.

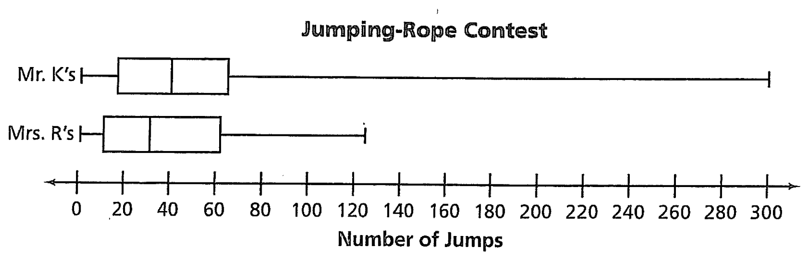
E. **1.** If a distribution is symmetric, the median will be in the center of the box; if it is skewed, it will be closer to either Q1 or Q3. The median may even fall on Q1 or Q3.

2. For Mr. K's class, the box indicates a more symmetric distribution even though there are some extreme values (outliers). Once the outliers are identified, the remainder of the box plot does suggest a more symmetric distribution.

3. For Mrs. R's class, the distribution does seem slightly skewed to the right; the median is a little off center, located more to the left in the box.

4. Once the outliers are marked in Mr. K's class, it is easier to see how to compare the two classes' data. They are more similar than different without consideration of the outliers.

Figure 1



At a Glance

Problem 4.3 Pacing $1\frac{1}{2}$ Days

4.3 How Much Taller Is a 6th-Grader Than a 2nd Grader? Taking Variability into Consideration

Focus Question How can you compare and contrast data represented by dot plots, histograms, and box plots?

Launch

Students consider different graphs of the same data sets and reflect on how each displays data. They also connect measures of center and measures of spread to the graphs to answer questions.

The data distributions are represented using dot plots, histograms, and box plots. Have students review how each graph is made.

Explore

Suggested Questions

- *What do you notice about the shape of the data?*
- *How can you answer, "How much taller is a 6th grader than a 2nd grader?"*
- *How does knowing that there is more variability in the 6th-grade data influence how you will decide how much taller a 6th-grade student is than a 2nd-grade student?*

Summarize

It may be helpful to set up a two-column table with one column labeled 6th Grade and the other labeled 2nd Grade. Then, for both, fill in observations. Fill in comments about shape. Continue with spread. Compare categories.

Materials

Labsheets
- 4.3: 2nd- and 6th-Grade Heights
- 4ACE: Exercises 17–19

Assessments
- Self-Assessment
- Notebook Checklist
- Unit Test

- calculators
- Data and Graphs Tool

ACE

Assignment Guide for Problem 4.3

Applications: 17–26 | Connections: 30, 32

Answers to Problem 4.3

A. 1. 84 students; Sample explanation: I counted all of the dots on the dot plot. There were 84 dots, so 84 6th-grade students must be represented.

2. The shape of the dot plot and histogram mirror each other in terms of shape, probably because the interval sizes in the histogram are each 2 inches. In the dot plot, each data value is shown on the number line; in the histogram, data are grouped so the heights of the bars are taller than the dot plot stacks. There is an outlier that is marked on the box plot.

AT A GLANCE 4

3. The cluster at 62 is clear on the dot plot. Without the detail from the dot plot, the histogram can only tell you there is a cluster in the interval from 62 inches to 64 inches. From the histogram, you cannot tell whether there is an equal number of dots at 62 and 63, or if there are more dots at one axis label than the other. There are no gaps but you cannot tell that from the histogram or box plot. The dot plot shows there is no data value at 72, but that is not a real gap.

4. All three graphs show the range as 17 (56 to 73). The box plot tells you the middle 50% of the data is between 61 and 66. The other measure of spread, MAD, is not visible on a graph. The data are not spread evenly around the center. The data on the right of the graph is more spread out than the data on the left. You can see this most clearly from the box plot: both the right side of the box and the upper whisker are longer.

5. The dot plot and histogram are similar except that the histogram groups data in intervals of 2. The box plot seems the least like the other two graphs, but it does show the same cluster of data from 61 to 66 inches as the other graphs do.

B. 1. 84 students; Sample explanation: I found the height of each of the bars in the histogram. I added all of the heights together. The sum was 84, so there must be 84 students represented in the histogram.

2. The 2nd-grade data seem less spread out than the 6th-grade data. There is one outlier at 60 inches, but the IQR of the 2nd-grade data is 2 inches less than the IQR of the 6th-grade data. The graph is mainly symmetric around the median, but slightly skewed to the left.

3. The data cluster between 47 and 56 inches. There are really no gaps, unless you count the lack of data values between the outlier and the rest of the data. All three graphs show this gap clearly.

4. The distribution is much less spread out than the 6th-grade distribution. The IQR is only 3 inches, as compared to the IQR of 5 inches for the 6th-grade data. The mode of the 2nd-grade heights is 52 inches, but 53 and 54 inches are also frequent data values. Heights less than 50 inches and greater than 55 inches occur infrequently. The graphs are more symmetric than the 6th-grade distribution. All graphs show this: the data to the right of the graph has a similar shape to the data on the left of the graph in both the histogram and the dot plot. In the box plot, the whiskers are about the same length, as are the left and right sides of the box.

5. The dot plot and histogram are similar except that the histogram groups data in intervals of 2. Their shapes are very similar. The box plot shows the five-number summary of the dot plot and the histogram, which helps you pick out important summary statistics as well as outliers.

C. 1. Sample answer: The mean of the 6th-grade heights is 63.1 inches, and the mean of the 2nd-grade heights is 52.21 inches. This means that 6th graders are about 11 inches taller than 2nd graders. If you used the medians (62 inches and 52 inches), then 6th graders are, on average, 10 inches taller than 2nd graders. The difference of the means is about the same as the difference of the medians, so either calculation works well. The dot plot also shows that 6th graders are about 10 inches taller than 2nd graders. The mode of the 6th-grade data is 10 inches more than the mode of the 2nd-grade data. Also, the maximum and minimum values are close to 10 inches apart for the 6th-grade data and the 2nd-grade data. 2nd graders range from 47 inches to 60 inches in height, and 6th graders range from 56 to 73 inches in height.

2. The mean and median comparisons will be the same as for part (1). Possible comparison of the histograms: The most frequent range of data values for the 6th-grade data is 62 to 64 inches. The most frequent range of data values for the 2nd-grade data is 52 to 54 inches. Again, this shows that 6th-graders are about 10 inches taller than 2nd-graders. As in part (1), you can also analyze the maximum and minimum values (or ranges of values) by looking at the histograms.

3. The mean and median comparisons will be the same as for part (1). Possible comparison of the box plots: The medians are clearly shown on the box plots, so the 10-inch difference between 6th-grade heights and 2nd-grade heights is clear in the box plots. The minimum values also show about a 10-inch difference (56 and 47). The box plots, however, show a greater distance in the maximum values. Since the maximum value of the 2nd-grade data is an outlier, you may want to disregard that value. Then, comparing the right-hand whiskers of each box plot, the difference of the greatest 6th-grade height and the greatest 2nd-grade height is 73–56, or 17 inches. On all other measures (minimum values, Q1, median, and Q3), the difference between 6th-grade height and 2nd-grade height is about 10 inches.

4. Answers will vary. Some students may choose box plots. This type of representation clearly shows comparisons of medians, Q1s, Q3s, minimum values, and maximum values between the two groups. There is one outlier in the 2nd grade. Otherwise, all the 6th grade students are taller than all the 2nd grade students. Generally, students could say that the 6th-grade students are about 62 inches tall (the median) and 2nd-grade students are about 52 inches tall. So, 6th-grade students are about 10 inches taller than 2nd-grade students. If students use histograms or dot plots to display the data sets, they will most likely focus on mean, median, and skew of the data.

D. On all the measures of spread, there is greater variability in the 6th-grade heights.

E. Answers will vary. Sample response: I already have data on 84 6th-grade students. So I would just need to collect data on 8th-grade students. I would try to find data on 84 8th-grade students so that my graphs have about the same number of data values. If I couldn't find 84 8th-graders, though, some similar number would be fine. I would find the mean and median of the data from the 8th-grade students and compare them to the mean and median of the data from the 6th-grade students. I think I would choose a histogram or a box plot to display the data values. Since there are so many data values, displaying a dot plot would take way too much time.